ACORN COMPUTER
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ACORN TECHNICAL MANUAL

Atom Colour Encoder.....202,001

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INTRODUCTION

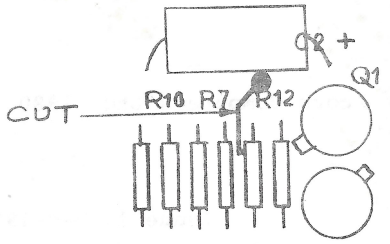
The standard Atom computer is fitted with a 6847 character generator circuit which produces a monochome (black-grey-white) video signal, this signal is used to generate two outputs from the Atom circuit board, a 1 volt composite video signal suitable for driving monitors, and a UHF output for feeding to the aerial socket of a TeleVision receiver. The 6847 also produces colour information which is not used on the standard Atom computer. The Atom Colour Encoder fits inside the Atom case where it plugs on to the main circuit board and from the colour information it makes a composite PAL colour video signal which is then used to drive the UHF modulator. In this way a colour display can be produced on a TV receiver.

If the Colour Encoder is purchased at the same time as an Atom kit the encoder should be put to one side and the Atom made to work in monochrome first.

INSTALLATION AND OPERATION

Before installing the Colour Encoder board check visually that it is not damaged in any way. Undo the two screws which secure the bottom of the Atom case. The Atom circuit board must be fitted with two rows of 5 pins in position PL4 and these pins are fitted to all Atoms manufactured after 01/01/81, if they are not present the four screws which hold the Atom board in the case top will have to be removed so that the pins can be soldered in. The pins are mounted in a strip moulding and this should be on side 2 of the Atom circuit board with the short end of the pin pushed through the holes for PL4 and soldered on side 1 of the Atom board. After soldering screw the Atom board back into the case top.

It is necessary to break the existing connection between the video amplifier and the UHF modulator. This is done by gently pushing C2 towards the rear of the Atom board exposing the Plated Through Hole illustrated in the diagram. Cut the copper track on side 2 as shown and then solder a piece of wire about 1 inch long to the PTH.-



Now the Colour Encoder can be plugged on to PL4 and the other end of the wire soldered to the output PTH on the encoder board. Secure the Colour Encoder with a double sided sticky pad on the top of IC31.

Before fixing the case bottom the Colour Encoder should be tested. Connect the UHF modulator output to a colour TV and supply power to the Atom. Tune the TV to channel 36 and press Break on the Atom, the Acorn Atom prompt should appear in yellow on a green background. If no colour is obtained it may be that the sub-carrier frequency is incorrect, adjust VC1 on the encoder board with a small screwdriver, also check that the colour controls on the TV are set correctly. A ripple is produced by the encoder on the vertical edges of colours and it can not be removed, however a slight adjustment of VC1 will minimise its visual effect.

The following program can be run in the Atom in order to test the Colour Encoder.-

```
10  ?#B000 = #10
20  FOR Z = #8000 TO #8400 STEP 4
30  !Z = #FFAA5500
40  NEXT Z
50  DO UNTIL ?#B001 < 128
60  ?#B002 = ?#B002 : 8
70  DO UNTIL ?#B001 > 128
80  GOTO 50
90  END
```

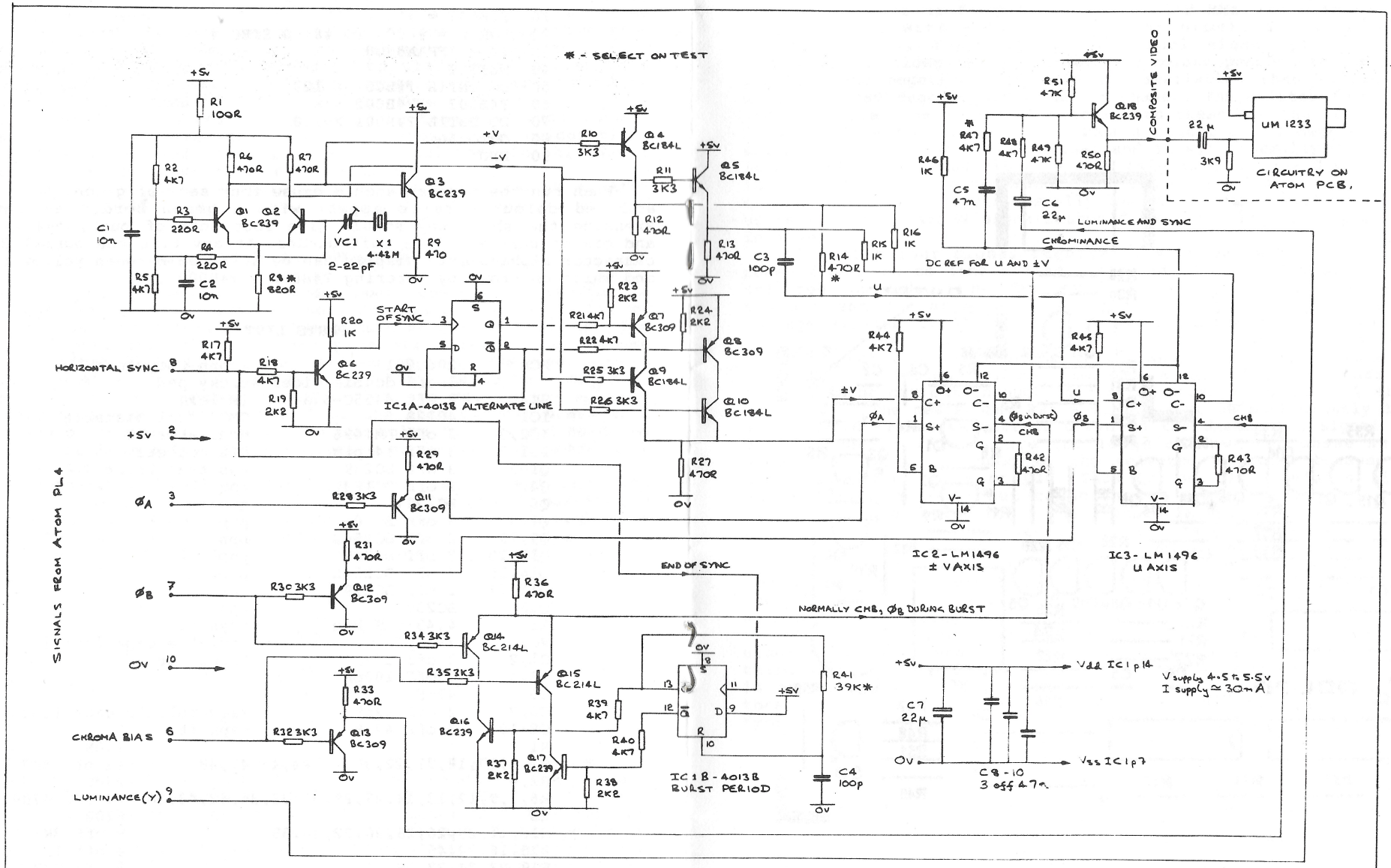
When run the program should cause four sets of green, yellow, blue and red colour bars to appear with a green border around them. Pressing the shift key should give four sets of buff, cyan, magenta and orange bars within a buff border. At any time the normal 32 by 16 character alphanumeric display can be switched between yellow on green and white on brown by entering ?#B002 = ?#B002 : 8.

PARTS LIST

PCB	200,001	Acorn Computers
	1 off double sided sticky pad	
SK4	2 off 4455C-5way	(Molex)
IC1	4013B	CMOS dual bistable
IC2,3	2 off LM1496	Modulator IC
IC1-3	3 off 14 pin	DIL sockets
Q1-3	3 off BC239	npn transistor
Q4,5	2 off BC184L	npn
Q6	BC 239	npn
Q7,8	2 off BC309	pnp
Q9,10	2 off BC184L	npn
Q11-13	3 off BC309	pnp
Q14,15	2 off BC214L	pnp
Q16,17	2 off BC239	npn
Q18	BC239	npn
X1	4.433619 MHz	crystal
VC1	2-22pF	variable capacitor (RS 125-654)
C1,2	2 off 10nF	capacitor
C3,4	2 off 100pF	
C5	47nF	
C6,7	2 off 22uF	electrolytic capacitor
C8-10	3 off 47nF	capacitor

R1	100R
R2,5,17,18,21,22,39,40,44,45,47,48	12 off 4K7
R3,4	220R
R6,7,9,12,13,14,27,29,31,33,36,42,43,50	14 off 470R
R8	820R
R10,11,25,26,28,30,32,34,35	9 off 3K3
R15,16,20,46	4 off 1K
R19,23,24,37,38	5 off 2K2
R41	39K
R49,51	2 off 47K

CIRCUIT DIAGRAM



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CBT	ATOM PAL ENCODER	202,001/C	
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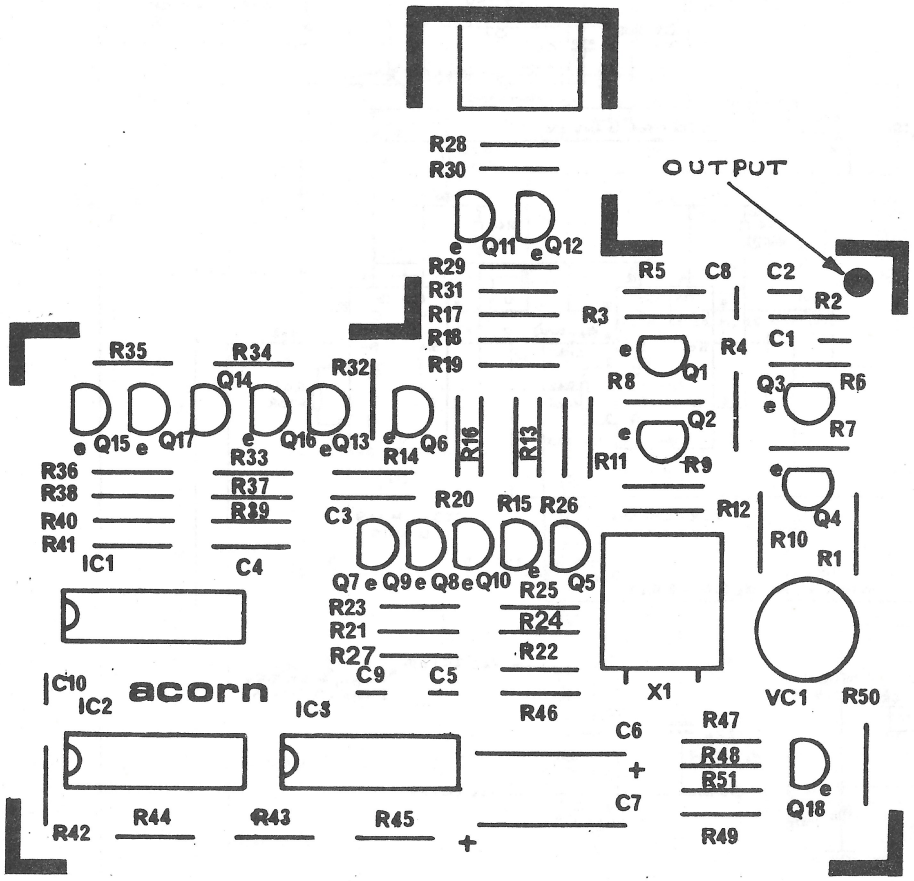
CIRCUIT BOARD LAYOUT

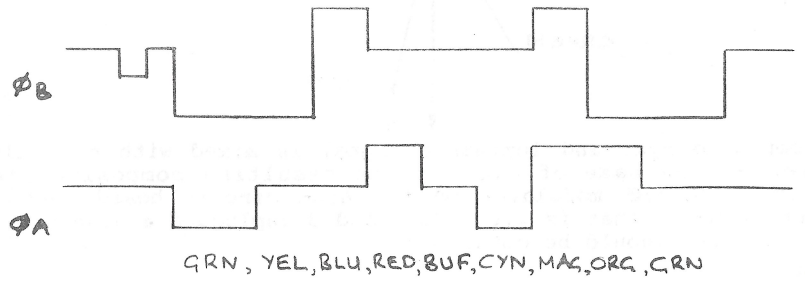


CIRCUIT DESCRIPTION

Transistors Q1, Q2 and Q3 form an oscillator which generates the colour sub-carrier frequency of 4.433619 MHz, this is set by the crystal, X1, with a fine adjustment provided by the variable capacitor, VC1. The roughly sinusoidal signal produced by the oscillator is along the V axis of the colour phasor diagram and both positive and negative V signals are available (that is two signals which are 180 degrees different in phase). The emitter followers, Q4 and Q5, buffer the +V and -V signals and these are then fed to the RC network, C3 and R14, which produces a signal at 90 degrees to the V signals. This is the U axis signal and it will normally be triangular in appearance. R15 and R16 give a DC reference for the U and V signals in order to bias the modulators and reject any common mode component on the oscillator outputs. Usually the DC reference will be around 3.5 volts and the U and V signals should be about 1.0 volts peak to peak in size.

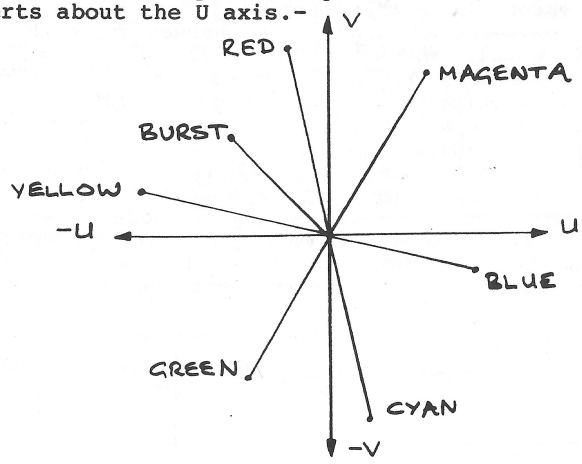
The PAL colour signal requires a V output which alternates in phase from line to line and so either of the +V or -V signals may be selected for modulation. Emitter followers, Q9 and Q10, buffer the V signals and the selection is determined by which follower has a voltage applied to its collector. The selected follower has a high input impedence and a low output impedence and so the selected V signal is not attenuated by R25 or R26 and it produces a signal across R27. The deselected follower becomes a foward biased base-emitter diode and the current through this attenuates the unwanted V signal in R25 or R26. The resistors, R25 and R26, must be sufficiently large so as to avoid excessive current drain on the deselected signal from Q1 or Q2, however if they are too large an unwanted phase shift and attenuation will be added to the selected V signal because of the input impedence of Q9 or Q10. Thus Q9 and Q10 should be high gain devices with a low input capacitance. Transistors Q7 and Q8 are switches through which the 5 volt supply is applied to the collectors of Q9 and Q10. The selected signal is changed on each line by the bistable circuit in IC1A which is triggered by the leading edge of every horizontal line sync pulse, therefore the Q outputs of IC1A should have square waveforms with a period of 128 micro-seconds on them. Transistor Q6 is a switch which gives an inverted H sync pulse with a positive going leading edge.

The colour information from the 6847 is carried on two analogue signals called Oa and Ob, these must be detected with reference to a third signal called CHroma Bias and so common mode noise and DC drift is accounted for. The pnp emitter followers Q11, Q12 and Q13 buffer these signals and they are then fed to modulators. The diagram shows typical Oa and Ob signals for a line with eight colours on it.-



At the beginning of each horizontal line a reference colour must be produced with which the TV receiver can compare other colours it receives in order to display colours in their correct hue, this reference is the colour burst and it exists for a period of 3.5 micro-seconds starting after the trailing edge of the H sync pulse. The reader should realise that the displayed colour is defined by its hue and saturation and that this information is carried by the subcarrier as phase shift and amplitude, that is a phasor on the U and V phasor diagram. In order to produce the correct reference colour one of the modulator inputs must be switched from CHB to Ob during the burst period. The period is determined by the monostable, IC1B, whose period is set by R41 and C4. This monostable is triggered by the positive going trailing edge of the H sync pulse and its outputs select between CHB and Ob by switching the supplies to the collectors of the emitter followers Q14 and Q15. This section of the circuit is designed with the same considerations as the V signal selection. In addition it is important that the correct reference is maintained between Oa, Ob and CHB so that the correct colours are produced, therefore the Oa, Ob and CHB signals are all passed through one base-emitter junction of a pnp emitter follower and so they should track each other during temperature changes.

Two modulator circuits are used, IC2 and IC3, these are LM1496 integrated circuits and they produce colour sub-carrier signals on the V and U axes respectivly. The carrier signal to be modulated is applied to the C+ input with its reference on C-, the modulating signal is then applied to the S+ input with its reference on S-. The U and V axis signals from the modulator outputs are then combined in the common load resistor, R46, to produce the complete colour sub-carrier, that is a signal at a frequency of 4.433619 MHz whose phase and amplitude changes with colour when referred to the reference conditions at the start of each line. The colour phasor diagram is given for the combined output during a +V line, in a -V line the whole diagram inverts about the U axis.-



The composite sync and luminance signal is mixed with the colour sub-carrier at the base of Q18 and the resulting composite video signal drives the UHF modulator on the Atom circuit board. With no sub-carrier present, that is with ICs 2 and 3 unplugged a high quality monochrome display should be obtained.